PLASTICATION CONTROL SYSTEM FOR INJECTION MOLDING MACHINES

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BACKGROUND OF THE INVENTION

This invention relates to injection molding machines and, more particularly, to a control system for controlling the plastication system of such a machine so that the shot size and plastication time are automatically controlled to provide the plastication time and shot size selected by by the machine operator.

In the operation of injection molding machines, plastication is accomplished in a heated barrel within which a screw is rotatably and translatably positioned. The material to be plasticated, which can be, for example, polyethylene, polystyene, polypropylene, ABS, and the like, is placed in a hopper at one end of the barrel where it is fed to the screw by means of gravity. The screw works the material, thereby heating it by friction, to soften it so it subsequently can be forcibly injected into a mold while it is in a viscous but fluid state. In addition to softening the material, the screw also conveys it axially along the barrel to the point where it is discharged therefrom.

Heretofore, the set-up and operation of an injection molding machine was accomplished almost entirely manually and required that the operator of the machine set the various parameters such as screw speed, screw back pressure, shot size, and the like manually in order to provide molded parts of the desired quality within the desired cycle operating time. Because those steps had to be accomplished manually, there was a considerable time period involved in setting up the machine to mold a given part since some of the control variables are, to a degree, interdependent, so that a change in one could very well result in a change in another.

It is thus desirable to provide a control system whereby the functions previously performed manually are performed automatically to assure more uniform operating cycles and thereby provide more uniform molded parts. It is an object of the present invention to provide such an automatic control system.

SUMMARY OF THE INVENTION

Briefly stated, in accordance with one aspect of the present invention, control system is provided for an injection molding machine having a plastication system which includes a screw rotatably and translatably positioned within a barrel for injecting plasticated material into a mold. The machine includes means for rotating and translating the screw within the barrel and the control system provides means for controlling both the translation and rotation of the screw so that the plastication is achieved within the desired time period and so that the temperature of the resulting melt is maintained at a constant predetermined value. Means for calculating the speed of rotation of the screw to be employed during the next succeeding operating cycle are provided in order to correct the system and achieve the predetermined plastication time.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of a portion of an injection molding machine showing the mold cavity and plastication system together with the several elements of the control system of the present invention.

FIG. 2 is a graph showing the linear position of the screw in the barrel as a function of time and also as a function of the screw rotational speed.

FIG. 3 is a block diagram showing in further detail the controller forming a part of the control system shown in FIG. 1 and illustrating the several inputs and control loops therein.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings and particularly to FIG. 1 thereof, there is shown the plastication system **10** of an injection molding machine. The system includes a separable mold comprising a first mold portion **11** and a second mold portion **12** which when cooperatively engaged define a mold cavity **13** therebetween. Second mold portion **12** includes a passageway **14** providing communication between mold cavity **13** and the rear face **15** of second mold portion **12.** Abutting rear face **15** of the second mold portion **12** is a generally cylindrical barrel **16** which can have a tapered end portion terminating in an aperture **17** which is aligned with passageway **14** and connected therewith by means of nozzle **18.** If desired a shut-off valve (not shown) can be interposed between aperture **17** and passageway **14** in second mold portion **12** in order to permit communication between the interior of barrel **16** and mold cavity **13** only at predetermined times. As shown in FIG. **1,** barrel **16** can include a hopper **19** into which the material to be plasticated is loaded.

Slidably and rotatably positioned within barrel **16** is a screw **20** which can be of a known construction familiar to those skilled in the art. The screw includes one or more external flights **21** which are helically disposed thereabout to cause the material to be transported within the barrel from hopper **19** to outlet aperture **17.** Screw **20** includes a piston head **22** at its distal end, which piston head is surrounded by a cooperating cylinder **23** which when pressurized forces screw **20** in a forward direction toward outlet aperture **17** and thereby injects the plasticated material from within barrel **20** into mold cavity **13.**

Screw **20** also includes a driven gear **24** keyed or otherwise secured thereto and which is in intermeshing relationship with a driving pinion **25** which, in turn, is driven by a suitable motor **26.** Driving motor **26** can be either electrically or hydraulically driven, but a hydraulic motor is preferred from the standpoint of smooth operation. Also forming a part of screw **20** are a series of alternating circular grooves **27** and ridges **28** which are in engagement with a gear **29** which is attached to and drives a position transducer **30.** The axial position of screw **20** is monitored by position transducer **30** which provides an electrical signal proportional thereto. Position transducer **30** can be, for example, a shaft angle encoder, a resolver, or the like.

In operation, the material to be plasticated is placed in hopper **19** and screw **20** is caused to rotate by means of motor **26.** In the course of rotating, screw **20** performs mechanical work on the material to be plasticated thereby heating it and causing it to become soft